4.2 No Action Alternative (Alternative 1)

Natural Environment (4.2.1)

EARTH (4.2.1.1)

Analysis of Alternative 1 indicates approximately 11,200 acres of the 15,657 acres of trust lands in the planning area are available for timber harvesting. In addition, there are approximately 3,577 acres mapped as unstable areas (Watershed Analysis ARSs 1,2,3 and 4) where harvesting will be either prohibited or significantly restricted by Watershed Analysis prescriptions. There would be approximately 876 acres of riparian buffer, and 18 acres of wind buffer. No large areas are identified as potentially inaccessible to harvesting under this alternative. An average of 89 acres of regeneration harvesting and 47 acres of thinning of young stands and 11 acres of partial cut harvesting of older stands would occur annually.

About 61 miles of new road will be constructed during approximately the next 60 years. Approximately 1.7 miles of this road construction would occur on slopes mapped as unstable and 1 mile of road would be constructed on slopes designated as potentially unstable over the 60 year period.

Impacts on Slope Stability

Removal of support from steep, unstable slopes and potentially unstable slopes while constructing full-bench road segments could result in localized debris slides. Impacts may include damage to the new road prism or road closure, blockage of drainage facilities, and short-term, increased sedimentation into stream channels. Over the longer term, slope movement processes could be affected by road construction in these areas. Road-cut excavations on slopes greater than 70 percent likely would destabilize the slopes above, resulting in slope movement along and above the road-cuts during and following periods of wet weather. Debris from these events could plug drainage structures, redirecting storm-water runoff and snow melt onto unstable slopes, and triggering local slope movement, resulting in debris flows within unstable channels. The redirected runoff also could wash out portions of affected road segments, adding to the sediment load. Sediment carried downstream likely would reach fish habitat, as well as public and private facilities and structures.

The potential impacts described above are substantially mitigated in this alternative by adherence to the Watershed Analysis prescriptions regarding road construction. These prescriptions prohibit road construction on the steeper slopes and most sensitive areas, and require a variety of design and construction measures such as full bench/end haul (no sidecast) construction, slope buttressing, limits on construction season, bridges or rock fills at stream

crossings, and maintenance of existing drainage patterns to prevent or avoid slope failures that would significantly impact water quality or fish habitat.

Root structure remaining in stumps after timber harvest activities would decompose over time and, to the degree that the root structure is not replaced by new vegetation, the capacity of root structure to hold near-surface soils in place would be reduced. This reduction in root structure could result in debris slides and surface erosion on potentially unstable slopes, particularly where mineral soil is exposed. Sediment from these events likely would be delivered directly to stream channels and down gradient to fish habitat. This potential impact is mitigated by DNR's use of a slope stability specialist in its harvest design to identify and avoid or limit harvesting to selective tree removal on slopes that have the potential to become destabilized due to loss of root strength from harvest activity.

Regeneration harvests in stands of conifer timber will increase the amount of water entering soils during relatively infrequent combinations of climatic conditions commonly referred to as rain-on-snow events. Harvested areas would remain susceptible to such soil-water increases until a forest canopy becomes re-established. The potential for harvesting to increase soil-water levels during rain-on-snow events is significant; however, the slope stability consequences of soil water increases is largely dependent on site-specific topographic, soils, geology, and vegetation conditions. The likelihood that a specific area within the watershed will experience a rain-on-snow event increases with elevation and is greatest above about 1700 feet.

The potential for future slope failures affected by rain-on-snow events has been substantially mitigated in this alternative by adherence to Watershed Analysis prescriptions that limit harvesting on areas where slope failures have occurred historically.

Harvesting on the mapped unstable slope areas is significantly limited by the Watershed Analysis prescriptions, which are designed to prevent or avoid slope failures that would impact water quality or fish resources. However, shallow rapid slope failures could occur in the identified unstable areas, resulting in sedimentation to down-slope streams. No probable significant impacts to slope stability are expected from harvest activities under this alternative.

Impacts on Erosion

Short-term impacts on stable slopes would include local erosion of exposed soils on cut and fill slopes during road and landing construction, and along log skid trails during timber harvest. Cut-slopes constructed steeper than 1.5H:1V (horizontal and vertical) in soil likely would produce impacts similar to those in unstable and potentially unstable areas, but on a smaller scale. No significant impacts on aquatic resources are contemplated. This erosion of

exposed cut and fill slopes is partially mitigated by rapid re-vegetation of these slopes, and direction of ditch water onto the forest floor away from flowing streams. These practices are currently being done as part of the road construction process.

Cumulative Impacts

The cumulative impacts from implementation of this alternative include increased delivery of sediment to streams and fish habitat over natural levels. Due to requirements under Forest Practices Rules and the HCP, these impacts are not expected to be significant.

Additional Mitigation Measures

Paving the roads and drainage ditches to reduce erosion could reduce sediment from roads even more. The miles of new road construction within unstable or potentially unstable terrain could be reduced or eliminated by use of helicopter logging for areas where conventional logging systems would require construction of roads through unstable or potentially unstable terrain.

Unavoidable Adverse Impacts

Road and landing construction activities would result in some short-term increases in sediment production, even if potential impacts were mitigated.

AIR (4.2.1.2)

Climate/Air Quality

Potential pollutants from activities proposed under Alternative 1 could include dust from logging truck traffic on dirt roads. Smoke from wildfires and silvicultural burning may also introduce pollutants, although to date wildfires have been very infrequent and inconsequential in size and little future silvicultural burning is anticipated under this alternative. No activities are proposed under Alternative 1 that would be anticipated to impact the Air Quality Index rating. At present, the Air Quality Index indicates the Bellingham area is rated as "Good," the healthiest rating. Air quality in the planning area will continue to be monitored by the Northwest Air Pollution Control Authority, although no significant adverse impacts are expected.

Short-term Impacts: Direct and Indirect

Traffic on dirt roads will result in some short-term generation of dust in the immediate area of operation. If wildfires or silvicultural burns do occur, these may also result in short duration, localized smoke plumes.

Direct impacts may include short-term eye and respiratory discomfort from exposure to dust and smoke for individuals working or recreating in the immediate area of operation. Direct impacts may be minimized by avoiding the areas of operation when dust or smoke is likely to be generated, and will continue to be reduced by current DNR practices of abating dust from roads during harvest operations where it has the potential to impact adjacent residences. Smoke emissions will continue to be minimized through application of DNR's Smoke Management Plan, and wildfire response by local fire districts and DNR fire personnel.

The only potential indirect impact identified is the possibility of temporary, localized hazes from dust or smoke. However, the size of operational areas, use of dust suppression methods, and size and infrequency of wildfires or silvicultural burns should preclude the potential for any significant indirect impacts as dust and smoke emissions will be small, isolated, and infrequent, resulting in rapid dissipation of dust and smoke plumes.

Long-term Impacts: Direct and Indirect

No long-term direct or indirect impacts have been identified or are anticipated. The potential for releases of and resultant impacts from mercury as a result of wildfire or silvicultural burning was raised as a concern during scoping. However, the infrequency and size of wildfires as well as very little silvicultural burning being proposed in alternative 1 precludes the potential for such releases and impacts. There also is little to no evidence suggesting mercury would be released as a result of wildfire or burning within the planning area.

Cumulative Impacts

No cumulative impacts to air quality have been identified or are anticipated.

Additional Mitigation Measures

No additional mitigation is proposed. Existing rules and regulations relating to control of dust and smoke emissions are considered adequate for preventing and mitigating any potential impacts under this alternative.

Unavoidable Adverse Impacts

No unavoidable adverse impacts to air quality have been identified or are anticipated.

WATER (4.2.1.3)

Surface Water Quality

As discussed under "Affected Environment," timber harvesting has the potential to affect surface water quality in respect to sediment, temperature and nutrients. The watershed analysis, lumping all ownerships, indicates sediment yields are above background levels, shade requirements are not being met on about 25% of the stream miles, and nutrient concentrations are low. The data is not immediately amenable to separating out state trust lands, but it can be assumed that improvements are needed at some level in all three categories.

Because timber stand establishment and growth to maturity requires decades, so when impacts occur from timber harvesting, they are often long-term and cumulative. This has three implications: (1) the conditions we see today on the ground are often not indicative of the practices of today but of past practices plus the first direct effects of today; (2) many of today's practices have not had time to play out relative to their cumulative outcomes, and (3) changing today's practices will not result in the full, desired outcomes to conditions on the ground for many, many years.

This is significant, since Alternative 1 reflects fairly recent changes in the department's state trust land management under the Habitat Conservation Plan and recent changes to Forest Practices Rules. Sediment levels, stream temperature and nutrient levels should all improve under this guidance. It is difficult to predict the magnitude of this change, but they were adopted to address these specific (and other) issues.

Under this alternative, the impacts of timber harvesting and roads on mass wasting are mitigated by the Lake Whatcom Watershed Analysis prescriptions and by Forest Practices Rules (WDNR, 1997a; WFPB, 2001). The analysis assigned hazard ratings to certain combinations of slope, landform and geology. Harvesting is not allowed on areas with a moderate or high hazard rating and with a potential for delivering sediments to water bodies or public works. Road construction is also prohibited under certain conditions. Where road construction is allowed on identified unstable slopes, assessment by a qualified specialist is required. Assessment of risk for failure and sediment delivery from orphaned roads also is required.

Watershed analysis prescriptions and Forest Practices Rules also mitigate sedimentation from road surface erosion (WDNR, 1997a; WFPB, 2001). This is done mainly through seasonal restrictions on construction and use along with specified methods for construction and drainage management. Minimizing road mileage also is required.

The impacts of timber harvesting on water temperature are mitigated by the riparian strategy of the 1997 Habitat Conservation Plan (WDNR, 1997b). Under this strategy, Type 1, 2, 3 and 4 waters will have buffers with a minimum width of 100 feet to provide shade. Buffers on Type 1, 2, and 3 streams will generally be wider because the width is based on the 100-year-site-potential tree height. Streams located in areas subject to windthrow will have an additional wind buffer.

Aerial application of chemicals will be the last resort following the policy of the Forest Resource Plan (WDNR, 1992). If this activity is used, however, direct application to surface waters will be avoided by following Forest Practices Rules that establish buffers based on wind conditions and application methods (WFPB, 2001).

Short- and Long-term Impacts: Direct and Indirect

This alternative does not have probable, significant adverse impacts. As stated above, current conditions on state trust lands should actually improve over time.

Additional Mitigation Measures

None identified as needed.

Unavoidable adverse impacts

Despite mitigating measures, some introduction of sediment from roads into surface waters is unavoidable. This is especially true for existing roads. It also is difficult to prevent all sediment entry when constructing stream crossings. Increases in nutrient concentrations resulting from timber removal cannot be prevented. However, the amount of change has been shown not to be significantly adverse (Dissmeyer, 2000).

Surface Water Quantity

Timber harvesting directly increases water yield as described under "Affected Environment". The activity with the highest potential for increasing peak flows in the Lake Whatcom planning area that is associated with flooding and channel change is timber harvesting at elevations from 1,700 to 2,900 feet. At these elevations, timber removal encourages longer retention of transient snowpacks and increases the rate of melt during rain-on-snow storm events. Currently, none of the forested watersheds within the Lake Whatcom planning area have significant increases in peak flows (WDNR, 1997a). However, Olsen and Smith Creek have been given a moderate peak flow sensitivity rating in the watershed analysis for future conditions (i.e., percent of forest hydrologically mature).

As explained above, timber stand establishment and growth to maturity requires decades. Timber stand recovery to a hydrologic mature state can require as much as 40 years in the Lake Whatcom Planning Area. So when impacts occur from timber harvesting, they are often long-term and cumulative. This has three implications: (1) the conditions we see today on the ground are often not indicative of the practices of today but of past practices plus the first direct effects of today; (2) many of today's practices have not had time to play out relative to their cumulative outcomes, and (3) changing today's practices will not result in the full, desired outcomes to conditions on the ground for many, many years.

Under Alternative 1, the impacts of timber harvesting on peak flows are mitigated by the watershed analysis prescriptions (WDNR, 1997a). These require maintaining a certain proportion of the timber in the Smith and Olsen Creek watersheds in a hydrologically mature condition.

The impacts of roads on peak flows are mitigated by the watershed analysis prescriptions and by harvest system planning. These measures tend to keep the active road miles to a minimum at any given time.

Short- and Long-term Impacts: Direct and Indirect

This alternative does not have probable, significant adverse impacts. As stated above, current conditions on state trust lands should actually improve over time.

Additional Mitigation Measures

None identified as needed.

Unavoidable adverse impacts

Increasing water yield when timber is harvested is unavoidable. Under sustained yield timber management, the increases usually are not great enough to become an adverse impact.

Groundwater Quality

The impacts on groundwater quality are covered by the discussion pertaining to soluble nutrients under surface water quality.

Groundwater Quantity

The impacts on groundwater quantity are covered by the discussion on surface water quantity.

Public Water Supply

The impacts on the Lake Whatcom municipal water supply are the same as those discussed under surface water quality. Therefore the mitigating measures for protecting stream water quality also will benefit the water quality of the lake. Because increases in water yield are unavoidable, increases in annual nutrient loading also is unavoidable. However, they will not be great enough to adversely affect water use.

PLANTS AND ANIMALS (4.2.1.4)

Forest Vegetation: Upland, Riparian, Wetland

Upland Vegetation: General Forest Ecology Perspective

Short-term changes to upland forests through DNR's current management strategies can be characterized, in general, by the ratios of forest development stages that exist across the landscape through time. Under this alternative, regeneration harvests would keep more of the landscape in younger seral stages for a longer period of time than under the other alternatives. However, the landscape-wide effects of this harvesting activity would not be obvious in the short term. Harvesting activity under Alternative 1 would require maintenance of roads and new road building, and this could result in short-term impacts adjacent to the activity. Canopy removal, soil disturbance and resulting changes in vegetation on and adjacent to active timber sales are other short-term impacts related to harvesting.

Younger seral stages translate to less floristic diversity of all strata, except the early seral herbaceous and shrub species that establish following disturbances such as fire or timber harvest. When higher proportions of the forest are in a pole timber or closed condition, less light penetrates, limiting the understory species that are able to establish under the canopy. Few canopy gaps are associated with younger seral stages, and snags and coarse woody debris are few, most being residual from prior stands. Overstory over a high proportion of the landscape will be predominantly early-seral shade-intolerant species such as Douglas-fir (*Pseudotsuga menzeisii*).

Approximately 50 years from the present, the landscape will have transformed from one in which the dominant forest development stage is 40 to 70 years old ("closed" condition), to one where the dominant age class is over seventy years ("complex" condition), with about 3% being over 150 years of age. At 100 years, 93% of the forest in the planning area will be over 70 years of age, and 30 % will be older than 150 years. 150-year-old forests are starting to take on habitat elements that are unique to older forest, including patches of all the younger successional stages.

Diversity in the overstory is in part dependant on having a variety of growth conditions available such as are provided by canopy gaps, established overstory and different microclimates resulting from varied forest cover. Down woody debris also plays a role in regeneration of overstory and shrub species, contributing to tree species establishment and diversity. Over time, having a greater proportion of the forest in a more mature condition will increase diversity of overstory and understory species, increase numbers of canopy gaps and snags and down logs, and increase structural diversity.

Short- and Long-term Impacts: Direct and Indirect

No short- or long-term probable, significant adverse impacts at the broader forest ecosystem level have been identified by this analysis. The landscape would be moving toward a forest with greater diversity, and a greater percentage of older forest. Mutually agreed upon measurable criteria for determining whether the rate of change is fast enough, at this broader scale, do not currently exist. But the direction of change is positive.

Cumulative Impacts

Cumulative impacts will be related to frequency of entry into the stands for forest practices activities. Cumulative impacts may be slight on non-compactable soils, when vegetation has time to recover between entries. On compactable soils, if rotation ages are too short to allow soils and vegetation to rebound, productivity could diminish over time, and with it the rate of forest succession. However, this is unlikely to occur.

Additional Mitigation Measures

Mitigation for cumulative impacts to soils due to frequent stand entries includes using longer rotations on more compactable soil types, seasonal restrictions on harvesting on compactable soils to avoid compaction when the soil is moist and most susceptible to damage and avoiding use of ground-based harvesting systems whenever feasible on compactable soil types. All of these measures are among the options available to DNR forest managers, and are likely to be used so there are no probable, significant adverse impacts expected.

Unavoidable Adverse Impacts

Unavoidable impacts are impacts due to roads, which reduce area of forest, increase forest edge and add sediment to and remove thermal cover from nearby streams and wetlands. However, there is currently no threshold for determining whether the degree of impact is significant or not at the broader, ecosystem scale. The potential for localized adverse impacts are addressed in the other sections.

Riparian and Wetland Vegetation: General Forest Ecology Perspective

The current management approach to riparian and wetland areas provides forested buffers adjacent to type 1, 2, 3 and 4 streams and wetlands over .25 acres in size. The department does not buffer smaller streams and wetlands unless needed for a site-specific reason, such as slope stability or protection of sensitive wildlife habitat. Buffers widths are dependent on the size of the wetland or stream and, often, the site index of surrounding conifer stands. At times these buffers may fail due to blowdown, resulting in an unknown risk. At times, smaller streams and wetlands are protected by clumping leave trees around them; however, this is not always done, and sometimes the leave trees blow down. Logs are sometimes yarded across Type 5 streams and wetlands, resulting in an as yet unquantified risk to resources.

Long-term impacts to wetlands and riparian areas may be the same as short-term impacts, depending on severity of disturbance and sensitivity of the particular site. All of the impacts listed above could potentially become long-term impacts under some circumstances. In extreme cases, disruption of wetland hydrology may cause water levels to rise in a forested wetland, precluding re-establishment of trees. Alternately, soil disturbances could drain wetlands, transforming them to uplands in the long-term. Permanent changes to hydrology generally result in permanent changes in vegetation form and composition. Riparian areas, many of which may include wetlands, are vulnerable to the same list of impacts as are isolated, (non-riparian) wetlands. Current forest practices, however, generally do not create this type of extreme disruption to wetland hydrology.

Short- and Long-term Impacts: Direct and Indirect

No short- or long-term probable, significant adverse impacts at the broader forest ecosystem level have been identified by this analysis. The most likely impacts are to wetland ecosystems under .25 acres and unprotected streams. If small, unidentified wetlands were disturbed in the course of harvest or thinning, impacts could be permanent, depending on the degree and type of disturbance. If subsurface flow is turned into channelized surface flow, this could result in permanent loss of acreage. The potential for other localized adverse impacts are addressed in the other sections.

Cumulative Impacts

While there is the potential that all impacts listed for wetland and riparian areas could worsen with successive entries depending on site sensitivity and degree of disturbance to hydrology and soils, it is unlikely due to DNR's current management practices. In addition, if impacts were to occur, it would be on a localized scale, and not at this broader forest ecology scale.

Additional Mitigation Measures

Impacts to wetlands less than .25 acres and unbuffered streams are probable impacts under this alternative. The significance of these impacts is not currently known.

Mitigation for impacts to small wetlands and unprotected streams is most ideally accomplished through avoidance. Effort can be made whenever possible to locate wetlands and headwater streams that are too small to show up on aerial photos (generally wetlands under .25 acres, and headwater streams that are not topographically obvious). This can sometimes be accomplished by looking at soil maps and topographical maps for clues to potential hydric soils and topography, and verifying conditions on the ground. When small wetlands and streams are located, leave trees can be clumped around them. Sale design can be used to ensure yarding through them is avoided whenever possible to protect wetland vegetation and soils.

Unavoidable adverse impacts

Unfortunately, some wetlands are so small as to defy detection by the means usually practiced, and will suffer impacts ranging from short-term loss of function to long-term loss of acreage and function.

Forest Health: Insects and Disease

The annual mortality and growth losses due to forest insects and diseases in the Lake Whatcom landscape is currently fairly low. On some sites laminated root rot is likely causing significant reductions in Douglas-fir volume. As the forest ages, it becomes more at risk of tree losses to Douglas-fir beetle, western hemlock looper, hemlock dwarf mistletoe, silver fir beetle, decay fungi, and weather-influenced maple decline.

The Forest Resource Plan directs that DNR incorporate forest health practices into the management of state forest land to bring about net benefit through the reduction or prevention of significant forest resource losses from insects, diseases, animals and other similar threats to trust assets (Policy No. 9: Forest Health). It is expected that forest health issues will be detected and addressed appropriately in harvest activities on managed sites (Objective 12.1), approximately 150 acres per year. Regeneration harvests will be a substantial portion of the annual management, providing opportunities to rejuvenate low vigor stands and make dramatic changes in structure and species composition if needed.

Short- and Long-term Impacts: Direct and Indirect

Although deferred management under the HCP likely contributes some commercial volume losses due to forest insect and disease activity, in some

areas this mortality has a positive benefit in correcting snag and coarse woody debris deficiencies.

In the long term, if unacceptable epidemics of forest insects or diseases develop, the HCP makes allowances to allow salvage efforts with mitigation strategies to protect conservation goals. (HCP Final EIS, pg 3-12).

No significant adverse impacts are considered likely under Alternative 1 relative to forest health.

Cumulative Impacts

No cumulative impacts are expected under this alternative.

Alternative 1 provides the most capacity for land managers to prevent and respond to epidemics of damaging forest insects, minimizing the potential for spread to adjacent properties. This capacity results from Forest Resource Plan direction to prevent the development of highly insect- or disease-prone forest structures or conditions, enabling active management, removal of windthrown trees, and suppression of developing insect populations using forest chemicals.

Additional Mitigation Measures

In areas where people work, concentrate, or recreate, risks from hazardous trees and snags can be evaluated and monitored. Mitigation actions can be taken to reduce safety risks.

Unavoidable adverse impacts

None anticipated.

Rare and Sensitive Plants

The only records for rare plants within the Lake Whatcom watershed are for two populations of *Lobelia dortmanna* (water lobelia), sighted in the 1930s and 1960s. It is unlikely that the forest practices activities represented by any of the alternatives would have much impact on *Lobelia dortmanna* in Lake Whatcom. All of the alternatives would tend, over time, to reduce nutrient inputs due to increasing levels of down wood in streams. This is because the movement of sediment, consisting of pulverized mineral and organic matter, carries nutrients downstream. Down wood in streams slows water, allowing sediments to settle rather than being carried downstream. It also creates dams behind which sediments accumulate. In alternatives 2-5, buffering of headwater streams would further reduce nutrient inputs to the lake. In all of the alternatives, water level fluctuations due to forest practices activities would be fairly minor and gradual.

Animals *(Habitat availability – quality, quantity, accessibility)*

Species-specific mitigation for most of the wildlife species of interest would be accomplished through implementation of the HCP. Most notable would include the development and implementation of Site Management Plans for bald eagle nests, and possible buffers and timing restrictions for any goshawk nests that are detected in the vicinity of management activities.

General mitigation for some of the potential impacts identified under Alternative 1 includes gating roads, and a road abandonment program. The HCP and Washington Forest Practices Rules (which includes retention of snags and legacy trees, as well as protection of special/unique habitats) already provide mitigation for some of the possible impacts identified above.

Short- and Long-term Impacts: Direct and Indirect

There are likely short-term, localized adverse impacts to individual animals whenever timber removal occurs. Besides an immediate loss of habitat, there is inevitably disturbance, or loss of, individual breeding sites (including loss of nests, young, etc.). This is particularly true for animals that breed in trees (i.e., birds, some small mammals), and is expected to occur for all of the alternatives, although to a lesser degree as one moves from Alternative 1 to Alternative 5. Long-term effects to animals (general wildlife) are addressed in relation to general habitat trends under "Habitat Availability", below.

Short-term impacts to bald eagles are expected to be negligible for all alternatives, as nesting areas will be protected from harvesting activities through management plans. Long-term impacts for all alternatives are expected to be generally favorable, as an increase in complex/mature forest (see discussion below, under "Habitat Availability") would result in an increase in large, structurally unique trees that are typically preferred by bald eagles for nesting and perching. There is potential for such positive impacts to increase with each alternative, although the realized effect on the population of breeding bald eagles is difficult to predict. More likely to affect bald eagles in the planning area are future human activities and resulting impacts to Lake Whatcom and other potential feeding areas for nesting bald eagles. Such impacts might include disturbance, development, fish stocking, and impacts to water quality caused by pollution and/or increased sediment delivery due to increased paving and other activities.

Common to all of the alternatives is the fact that significant adverse impacts are unlikely to occur for the following species of interest (provided that management activities follow the Forestry Handbook Procedures or PHS Management Guidelines for these species): common loon, great blue heron,

osprey, purple martin, and Townsend's big-eared bat. A detailed comparison of impacts for each alternative will not further address these species.

It can be noted that, as one progresses from Alternative 1 to Alternative 5, there is less potential over time for disturbance to occur at or near significant roosting sites or maternity colonies for Townsend's big-eared bats (or any of the Myotis species), due to an increase in "potentially inaccessible areas". Potential impacts to Yuma and Keen's Myotis are unknown, due to the lack of detailed information for these species. Since Keen's Myotis have been found to use tree cavities for roosting sites, further discussion under "Habitat Availability" regarding snags and cavity-nesting birds may apply somewhat to this species. There is also a general trend toward greater protection of amphibian habitat as one moves through the alternatives, due to increased stream buffers.

An analysis of the effects by alternative for several of the other species of interest is discussed below, under "Habitat Availability". The impacts to these species are primarily addressed according to changes in habitat conditions for specific guilds or life forms. These species include the olive-sided flycatcher (which is included in Life form 10), northern goshawk (Life form 11), pileated woodpecker (Life form 13), and Vaux's swift (Life form 14).

Habitat Availability (quality, quantity, accessibility)

Short- and Long-term Impacts: Direct & Indirect

Alternatives 1-4, as currently written, would result in a relatively rapid reduction of mature hardwood stands on the landscape. One goal of Objective 12 for the landscape plan that is common to these four alternatives is to "accelerate the harvest of mature and over-mature hardwood stands" during the first two decades of the landscape plan, and replace them with conifer plantations (i.e., "on sites better-suited for conifers").

Depending on how/why sites are determined to be "better-suited" for conifers, this could result in a large-scale conversion from mature hardwood-dominated stands to young conifer plantations. This would rapidly decrease habitat for many neotropical migratory birds and other species that are associated with hardwood stands for feeding, breeding, and/or life requirements. If some sites are determined to be suited for hardwoods but have reached their "climax" stage (for hardwoods), harvest followed by replanting of hardwoods would have a similar short-term impact of reducing this type of habitat, but a long-term impact of retaining this habitat component on the landscape.

Short-term direct impacts of Alternative 1 would include the removal of forest cover (loss of habitat) in areas of road construction and regeneration harvest.

Loss of habitat attributed to roads alone is generally two to four acres per mile of road. This would result in a reduction in the abundance of wildlife species associated with mid-seral forest in these areas. Another short-term direct impact of road construction would be the creation of a barrier to movement and dispersal of some wildlife species (Mader et al. 1990), although it may facilitate the movement of animals that use early-successional or edge habitat (e.g., deer, coyote, bear).

Short-term indirect effects of road construction and harvesting may include changes in microclimate of nearby stands/habitat, and an increase in bird nest parasitism (both attributed to "edge effect"). Other indirect short-term effects could include loss of existing snags (including on the edges of roads), a potential for increased human disturbance (primarily from use of new roads), and increased road-generated, localized sediment (i.e., "road effects"). For Alternative 1, the short-term change in forest cover types (i.e., stand structure/seral stage) on a landscape level would be minimal.

While all these short-term impacts are probable, it is less clear that there would be any significant adverse effect.

It is important to note that this analysis evaluates overall amounts or percentages of forest cover or habitat types on state lands within the planning area. What this analysis is not capable of evaluating is the potential sizes of particular harvest units, or their specific placement in space and time, as a detailed harvest plan has not been developed for each alternative. A harvest plan would provide a better understanding of the juxtaposition and distribution of habitat types on the landscape, which are important factors affecting many wildlife species (particularly interior forest species). A general idea of where harvesting could/could not occur within the planning area has been determined and is depicted for each alternative in Maps 1-5, Appendix C.

Following is an evaluation of current and future habitat conditions for selected life forms within the planning area. The percentage of suitable and primary habitat available for each life form under Alternative 1 is summarized through time in the table below.

For Life Form 8, there is projected to be a decrease in both suitable and primary habitat in the short-term. Within 10 years, the percent of habitat on state trust lands for this life form is expected to change from 60% suitable and 31% primary habitat to 56% and 26%, respectively (from hereon, these numbers will be listed in the order of suitable/primary). The long-term trend predicted for Life Form 8 would involve a relatively negligible change, with fluctuations ending at 64/32% after approximately 200 years (compared to 60/31% currently).

Table 13: Habitat Change under Alternative 1 relative to Selected Life Forms.

Life Form	Habitat Type[1]	2001	2005	2010	2050	2100	2150	2200
8	Suitable	60	64	56	63	66	59	64
	Primary	31	31	26	29	34	19	32
10	Suitable	87	91	81	95	94	95	90
	Primary	86	85	76	92	89	93	84
11	Suitable	93	92	88	96	94	96	92
	Primary	86	85	76	92	89	93	84
13	Suitable	72	78	73	83	81	89	79
	Primary	58	65	61	69	65	80	64
14	Suitable	79	83	80	85	83	90	82
	Primary	58	65	61	69	65	80	64

For Life Forms 10 and 11, there would be a short-term decrease in suitable and primary habitat. For Life Form 10 it would decrease from 87/86% to 81/76%, and for Life Form 11 it would decrease from 93/86% to 88/76%. For Life Forms 10 and 11, long-term trends for suitable and primary habitats are projected to increase within 50 years. The long-term trend (after 200 years) for Life Form 10 would result in a slight increase in suitable habitat (from 87% to 90%) and a slight decrease in primary habitat (from 86% to 84%). Both suitable and primary habitat would decrease slightly in the long-term for Life Form 11 (from 93/86% to 92/84%).

Life Forms 13 and 14 are expected to have very slight short-term increases in suitable and primary habitats (Life Form 13 would go from 72/58% to 73/61%; Life Form 14 would go from 79/58% to 80/61%). Long-term trends for Life Forms 13 and 14 would result in increases (from 72/58% to 79/64% for Life Form 13, and from 79/58% to 82/64% for Life Form 14).

A long-term, overall trend that would be common to all of the alternatives would be for wildlife species abundance and diversity to vary over time, as the result of naturally occurring vegetative succession. Succession would eventually favor species associated with older forest conditions, while dramatically reducing species associated with early-seral stages and, to a lesser extent, mid-seral stages. This would ultimately result in a reduction in "biodiversity" on the landscape level, even if site-specific, within-stand diversity increases. The temporal and spatial scale at which this would occur

[1] **Primary habitat** - A preferred or optimal habitat that predictably supports the highest population density of a species; that habitat upon which a species is essentially dependent for long-term population maintenance.**Secondary habitat** – A habitat that is used by a species, but is clearly less suitable than primary habitat, as indicated by a lower population density or less frequent use. A habitat may be designated as secondary where it is known to be used by a species but data are insufficient to clearly identify it as a primary habitat.(Brown, 1985)

is the key difference between the alternatives. See Table X5, Appendix D for the percentages of each seral stage on the landscape over time for each alternative.

A long-term direct impact of Alternative 1 would be a shift in age class/seral stage distribution from a mid-seral dominated landscape to one dominated by complex/mature forest. After approximately 200 years, there would be fluctuations, but an eventual increase in the regeneration stage, and a significant increase in complex/mature forest. A small but notable increase in the "fully functional" seral stage would also occur over time (after approximately 150 years), although only a small amount of true "old-growth" would exist in the planning area.

Long-term indirect impacts should result in an increase in structural components such as snags and downed wood over the landscape, as current procedures under the HCP encourage the retention (and possible creation) of snags and "legacy" trees when possible. "Legacy" trees often include larger-diameter trees with structural characteristics important to wildlife. Although snag retention is restricted by Department of Labor and Industry (L&I) safety guidelines, most leave tree plans include some level of protection for snags, often involving clumping leave trees to provide an L&I buffer (when one is necessary). Other snags are expected to develop through time within riparian areas, wetland buffers, and areas deferred from harvest due to unstable slopes.

The specific long-term impacts (direct or indirect) of road construction are difficult to predict, as the timing and exact locations of new construction and abandonment are not currently predicted. Where and how much road is built and/or abandoned is an important distinction related to effects on wildlife and wildlife habitat. However, roads can be addressed in a general manner, as a map has been created that depicts the possible road network that could be planned in the planning area under Alternative 1.

The portions of the planning area that would be most significantly impacted by road construction would include the middle-western portion, on Lookout Mountain, where there is currently contiguous mature forest with few roads. A relatively unroaded area in the southwestern portion would also be impacted. The areas that would likely be most significantly altered by road construction is the eastern (mid) portion, where a couple of main roads with spurs are planned in a currently unroaded area. The northeastern block of contiguous forest would actually experience limited impacts from roads, as only a few spurs are currently proposed coming off of an existing active road (which follows the powerline right-of-way). This would introduce minimal "road" and "edge" effect into the edges of contiguous forest, and would leave the interior portions intact.

Cumulative Impacts

Potential cumulative impacts under Alternative 1 could include the accumulation of roads or road beds, increased human disturbance, increased sediment/soil disturbance or transport, habitat fragmentation, and a decrease in habitat suitability for interior forest species (and a resulting decline in those species) for portions of the landscape.

Additional Mitigation Measures

A more aggressive road abandonment program could be initiated.

Unavoidable adverse impacts

Unavoidable adverse impacts for Alternative 1 include habitat fragmentation, the reduced ecological value or habitat suitability of unroaded areas, the unavoidable loss of some existing snags, and the resulting changes in wildlife species utilizing the planning area. It is difficult, with current knowledge, to determine how significant these impacts might be.

Fish

The fish of Lake Whatcom include native cutthroat and kokanee, and all other introduced salmonids. Non-salmonids are not specifically covered by this analysis; but because of their general habitat needs, will be considered protected by the measures provided for salmonids. In forested watersheds, salmonid habitat is provided when the full range of riparian ecosystem processes are maintained, including maintenance of watershed hydrologic maturity. Riparian ecosystems include the active channel (100 year floodplain), and an adjacent forest corridor on either side of water bodies that provides protection for five principal salmon habitat features: 1) water temperature, 2) streambank integrity, 3) sediment load, 4) detrital nutrient load, and 5) delivery of LWD. Large woody debris is considered especially important in the design of buffer widths because of the fundamental role it plays in aquatic ecosystems. Also, the width of riparian management zone (RMZ) necessary to fully provide for large woody debris, is greater than that necessary to provide for the remaining four salmonid habitat features; therefore, it is assumed for this analysis that if a buffer sufficiently provides for protection of LWD processes, then, by default, it also protects all other habitat features.

Habitat Quality and Quantity

Alternative-1 (no action) provides some protection from mass-wasting by following the Lake Whatcom Watershed Analysis mass-wasting prescriptions.

Alternative 1 provides riparian management zone (RMZ) protection on all Type 1, 2, 3 and 4 waters. The riparian management zone widths under Alternative 1 are generally assumed to be adequate to protect the habitat features. Wind buffers are also provided along larger fish bearing streams in areas prone to windthrow. These wind buffers, designed to reduce windthrow where wind is a problem, should prevent damage to the interior RMZ and help maintain and augment riparian ecosystem function.

No specific protection is provided for Type 5 waters (see details in the alternatives table in Section 3). By definition, most Type 5 waters have seasonal flow, are typically characterized by steep stream gradients, and are at relatively high elevations. A significant percentage of stream miles are Type 5.

The absence of RMZs on Type 5 waters could result in impacts to downstream fish-bearing streams. These impacts may come from sedimentation caused by logging-related streambank and side-slope erosion, water temperature increases caused by canopy removal, reduced LWD and detrital inputs due to the absence of leave trees, greater sensitivity to rain-on-snow events and other flooding with associated sedimentation and destabilization of large woody debris structures. These kinds of habitat losses can lower the overall fish productivity of tributary streams. However, the HCP, current Forest Practices rules and the watershed analysis all include rain-on-snow provisions. The watershed analysis identified two sub-basins as potentially sensitive for rain-on-snow; prescriptions were written for these areas.

Some protection is provided to Type 5 waters under Alternative 1 through unstable slope protection. Logging is avoided along Type 5 waters when they occur on unstable slopes; but minimal protection is given along Type 5 waters when they are on stable slopes since no specific RMZ is required. In addition, the department's HCP acknowledges the need to study how much protection is needed along Type 5 waters; this is currently under study, as part of the Habitat Conservation Plan agreement with the federal services.

Alternative 1 implements HCP and Forest Practices rules designed to reduce impacts from logging roads. These address unstable slopes and sediment from hauling and construction.

In Smith Creek, large woody debris will be cut into chunks to reduce debris build up, to reduce potential for debris torrents to occur.

Alternative 1 allows some silvicultural thinnings and tree species conversions within the RMZs, to accelerate recovery of the riparian forest to "older forest conditions". Silvicultural management within the middle and outer zones of the RMZ should result in long-term growth of large diameter conifer trees within the stream channel, and this will help stabilize salmon habitat. In some cases, tree thinnings and tree species conversions can be used to recover "older forest

conditions," and these forest conditions should generate higher quality salmon habitat in the long-term. Older forests provide large diameter conifer LWD trees, which contribute to structure and stability of productive salmon habitat. During silvicultural management activities there could be some short-term damage to riparian leave trees, but in the long-term, the riparian ecosystem should be enhanced. These management activities could result in some short-term negative impacts on water temperature due to canopy removal, some sediment runoff could reach the stream channel, and reduced detrital and LWD levels; but in the long-term the health of the riparian ecosystem would benefit.

Active restoration of the aquatic and terrestrial habitats is voluntary under Alternative 1; however, it can happen when outside funds, or those generated by timber removals, become available.

Short-and Long-term Impacts: Direct and Indirect

Alternative 1 may result in significant adverse impacts to fish habitat due to the lack of riparian management zones on Type 5 waters. These could be short- and long-term direct and indirect impacts as touched on above and in the "Affected Environment". There is debate over the probability of such impacts, which is one reason for the department's HCP-driven study of this issue.

The agreement to cut LWD into "chunks" in Smith Creek was meant to prevent the formation of large log jams that could break free in flood waters as large debris torrents. This action is being taken to protect downstream residents. It could, at the same time, result in short-term salmon habitat loss (e.g., removing large woody debris that creates in-channel pools) and would cause long-term stream channel instability and reduce salmon habitat. Based on geomorphology review of the watershed, such debris flows are a natural part of the stream dynamics in this area, resulting in pool formation and stabilization, followed by major washouts, followed by pool formation and restabilization.

Cumulative Impacts

Potential adverse cumulative effects on downstream fish habitats from soil compaction (logging and roads) and reduced hydrologic maturity are already addressed under Alternative 1. As identified under "water quality", the impacts of timber harvesting on peak flows in Alternative 1 are mitigated by the watershed analysis prescriptions (WDNR, 1997a). These require maintaining a certain proportion of the timber in the Smith and Olsen Creek watersheds in a hydrologically mature condition.

The impacts of roads on peak flows are mitigated by the watershed analysis prescriptions and by harvest system planning. These measures tend to keep the active road miles to a minimum at any given time.

Mitigation

Once the study of harvest and Type 5 waters is complete, science-based mitigation measures for potential fish habitat impacts could be designed.

Unavoidable Adverse Impacts

Whenever logging and road construction occurs in a watershed, there will be some increment of change to salmon habitat quality and quantity. The degree of change will depend on how much consideration is given to maintaining the natural watershed processes. Particular attention needs to be paid to maintaining vegetation composition and age characteristics, to keep erosion and runoff processes within the range of natural variability.

Some habitat change is unavoidable, and salmon living in steep headwater streams can adapt to low levels of habitat loss; but salmon adaptation to environmental change is vastly reduced when habitat impacts fall outside the natural background levels.

Habitat Accessibility

Habitat will remain accessible to all native fish species, at all life stages, on state trust lands. All fish-blocking culverts will be repaired with fish-passage structures, and replacement will occur during planned management activities or during implementation of the Road Maintenance and Abandonment Plan.

ENERGY AND NATURAL RESOURCES (4.2.1.5)

Energy Resources

Coal

Coal option contracts are for a term of one year, and allow conversion to a coal-mining contract. If coal option contracts were granted, exploration activity would normally include drilling with possible construction of temporary drill access roads. A coal-mining contract allows for the development and extraction of the coal. If sufficient quantities and quality were found to encourage development, the method of coal extraction would be determined, and be either by open pit or underground mining methods.

Each method has its own set of impacts. Open-pit mining obviously has the greatest potential impacts. Habitat, vegetation, air and water quality are some of

the impacts that would be significantly affected by this mining method. Underground mining would limit surface impacts to underground access points, surface-mine facilities, waste-rock storage and access roads. Impacts would include habitat impacts, if any, to the waste storage areas and facilities, possible water quality impacts and impacts from road construction and possible groundwater impacts. Selection of a mining method would depend on economic as well as physical characteristics of the resource, such as depth to the coal seam(s), coal quality and geologic factors.

On State-managed lands where the State holds the mineral estate, the DNR has discretion in permitting coal exploration and development activities through its leasing program. The decision whether to lease for coal development would be made after considering compatibility of these activities the management goals for each application to lease. Given the potential environmental impacts, and the limited likelihood of the success of permitting a coal operation in this environment, it is not likely that a lease would be issued for coal activities within the management area.

Short-Term Impacts

As there are no current exploration leases or mining contracts in the landscape planning area on state trust land, there are no short-term direct impacts for coal leasing or mining under Alternative 1. While the potential for future coal development within the landscape planning area exists, there currently is little demand or interest in this resource. Significant infrastructure would need to be developed such as a power generation plant, and/or gasification plant, rail or other transportation systems, and power transmission systems before this resource could be used. New lease applications under Alternative 1 would be evaluated on a case-by-case basis to determine whether a coal option contract or mining contract would be compatible with management goals and objectives.

On parcels where the state controls the surface but not the mineral estate, the state has no discretion with mining on these parcels other than determining surface damage amounts for any mineral activity.

Long-term Impacts

There are presently no long-term direct impacts from coal leasing. Future interest in leasing depends upon uncertain future demand. There currently is no agency program for generating coal-leasing activity. Revenue from leasing, however, could be significant. Studies would be needed at the time of lease applications to determine if leasing was compatible with land management goals for the area. Any approved activity would follow guidelines of the HCP, Forest Practices Rules and other applicable rules.

Proposed mining also would be guided by federal and state surface mine act permits, county permits, Ecology permits and other required permits.

An environmental review process would be required for a coal-mining contract. The review process would likely require an environmental impact statement. This would evaluate in detail multiple impacts, including air, surface and groundwater quality impacts, impacts to vegetation, threatened and endangered species, visual, noise and social impacts.

Cumulative Impacts

There are no cumulative impacts from coal exploration or coal mining activity at this time. There are no known operating coal mines on fee land within the landscape planning area, and therefore, cumulative impacts are minimal. Some of the historic mining activity may occur on or under a state parcel in the past, however. Future coal exploration or development on DNR land could generate impacts, but the leasing of land for this purpose is discretionary. The agency decision whether to lease land for coal exploration or development would be based on an assessment of management goals for any parcel where an application to lease was received.

Additional Mitigation Measures

Any future coal lease applications submitted and any exploration work would follow guidelines of the HCP, Forest Practices Rules, best management practices, reclamation guidelines and other protective measures as determined in the DNR approved plan of operations. A no-surface entry restriction could be imposed on any leasing, and any extraction of or access to coal resources could be restricted to subsurface only. Any exploration drilling or other activity could be restricted to existing roads, mitigating any new road construction impacts. In rare instance where a proposal was considered, mitigation specific to the proposal would be a part of environmental review during the permit request process.

Unavoidable Adverse Impacts

Leasing is a discretionary activity and restricting any new leasing would avoid impacts. However, impacts to the surface could occur where the state manages the surface but does not hold the mineral rights, if the holder of the mineral rights wishes to pursue mining activity. As stated earlier, the State has little discretion in this activity if it does not control the mineral estate. The state could require payment for surface damage.

Oil and Gas

Short-term Impacts

There is no short-term impact under Alternative 1 for the most recent lease, which expires in 2006. This lease does not allow any surface entry. Any drilling must be directional drilling from non-trust adjoining parcels. However, the strategy to allow development only if it is compatible with other landscape objectives cannot be applied to this lease. DNR can impose operational conditions but cannot deny development, as that right is already granted in the lease. For any future proposed lease, the intent under this alternative is for DNR to consider the compatibility of the proposal before allowing exploration. A lease would only be granted when both exploration and development met the landscape objectives, and would include appropriate operational conditions.

At least one lease application was rejected in the last oil and gas auction because the parcel was not accessible by directional drilling from a non-trust parcel. An older lease exists that does not have this no-surface entry condition. A plan of operation will need approval by DNR before any surface disturbance is allowed. Approval of the plan of operation would in part be that exploration would conform to operational conditions under the HCP, Forest Practices rules and Forest and Fish guidelines. Exploration activities could include surface geophysical surveys and drilling exploration wells, both of which would require road access to the parcel. To date, there has been no plan of operation submitted for exploration activity on this lease. The lease will expire on December 31, 2002.

There are no current indirect impacts from oil and gas leasing activity.

Long-term Impacts

The recent lease contains restriction for no surface entry, that is, no surface disturbance is allowed on the state oil and gas lease parcel. New leasing activity would be guided by the HCP, Forest Practices Rules and other applicable rules. Indirect impacts could occur from exploration activity on adjacent private land parcels, or on state parcels where the state does not control the mineral rights.

The one remaining lease without the no-surface entry policy expires at the end of calendar year 2002. No plan of operation has been submitted to date for this lease nor has any surface activity occurred. Therefore long-term impacts would not be generated from this lease. The no-surface drilling condition of Objective 16 of this alternative will limit any surface impact on any future leases. Exploration activity such as geophysical surveys on these types of

land may require forest road construction and maintenance. This activity may contribute some sediment to local drainage systems.

Cumulative Impacts

Leasing for oil and gas may occur on other private parcels or on DNR managed lands where DNR does not control the mineral rights within the landscape management area. Exploration activity such as geophysical surveys on these types of land may require forest road construction and maintenance. This activity may contribute some sediment to local drainage systems. However, there has not been any plan of operation submitted indicating the desire to conduct any exploration activity on DNR managed land. The no-surface entry requirement on recent leases and on any future leasing will eliminate contribution to cumulative impacts from DNR managed land, where DNR controls the mineral estate.

Additional Mitigation Measures

Any oil and gas exploration on the older lease could be restricted to existing roads. Any other activity would be required to follow direction and guidelines of the HCP, Forest Practices Rules, best management practices, reclamation guidelines and other protective measures as determined in the DNR approved plan of operations. As there is no surface entry allowed on the recent oil and gas leases, there would not be any impacts. Not allowing surface entry on any future oil and gas leases would also mitigate potential impacts.

If there is no restriction on surface activity in future lease, restricting access and activities to existing roads within the watershed will minimize additional road construction impacts.

Unavoidable Adverse Impacts

One current lease has a restriction on any surface activity. Impacts from the older lease could be impacts from access road and drill site construction, and drill activity, and possible from geophysical surveys. However, activities would be required to follow HCP, Forest Practices Rules and watershed analysis. DNR could impose restrictions to this activity if and when the lessee submits a plan of operation. The lease in question expires on December 21, 2002.

Hydropower

There is no current or potential hydropower resource within the landscape planning area, and, therefore, no likely impacts or necessity for mitigation.

Mineral resources

Sand, gravel and rock

Activities related to sand, gravel and rock extraction are limited by laws, but not by any of the proposal alternatives.

Short-term Impacts

Direct impacts from sand, gravel and rock pits are minimal, currently, only one noted borrow pit occurs on DNR-managed land within the landscape planning area. Gravel and rock resources on DNR managed lands are not particularly desirable for construction materials. The potential for commercial gravel or sales and operation on state land is very limited. Gravel or rock removal for local use, such as road maintenance or as road base material, is the only likely use for this material. Impacts from the existing borrow pit that is less than one acre in size are minimal. Some sediment discharge with stormwater could occur. The small size of the site would limit a significant sediment contribution. Objective 2 of this alternative addresses forest road maintenance and abandonment issues regarding road maintenance. Pit development also would follow these guidelines.

Indirect impacts also are relative to this potential use. Borrow pit operation could affect sediment load contribution, depending on the number of new pits. The small size of these pits would limit the sediment load contribution. Borrow pits on private land could contribute to the overall sediment load.

Long-term Impacts

Long-term impacts are similar to the short-term impacts. The limited nature of these resources within the landscape management area limits the long-term impacts of gravel or rock operations. Any future or long-term development would be small, limited to borrow pits of 0.2 acre in size related to road maintenance activity on forest roads. It is difficult to predict how frequent the long-term use of this type may be. It depends in large part on the amount of timber sales activity in the future.

Cumulative Impacts

Cumulative impacts from gravel or rock activity are limited to non-commercial borrow pit activity. As these types of pits are small, cumulative impacts would be based in part on the number of pits-developed in the future. Impacts could include increased sediment load contribution from stormwater run off.

Additional Mitigation Measures

Restricting commercial sales of sand, gravel or rock would mitigate impacts from this activity, although the potential for commercial development is limited. Restricting the number and/or size and location of forest road or other usage borrow pits would mitigate potential impacts. Other mitigation measures would be implemented by following guidelines under the HCP, Forest Practices rules and Forest and Fish rules, and recommendations of DNR specialists in the location of these activities.

Unavoidable Adverse Impacts

Some sediment load contribution could occur from road maintenance borrow pits. However, this would be limited as the size and number of pits would be small.

Metallic Minerals

There are no direct or indirect, short- or long-term impacts from metallic mineral activity as there are no metallic minerals reported within the landscape planning area. The rock types and geologic setting are not conducive for the occurrence of economic quantities of metallic minerals.

Industrial Minerals

Short- and Long-term Impacts

While some industrial minerals are present within the landscape planning area, they occur in other nearby areas that could be developed, and would therefore limit the need for exploitation in the landscape planning area, limiting any short-term direct or indirect impacts. The nature of the clay materials is either speculative or non-economic. The demand for this material is low, limiting the likelihood of development within the landscape planning area. The activity on state lands is a discretionary activity. Future leasing activity is highly unlikely, limiting any long-term direct or indirect impacts.

Cumulative Impacts

There are no cumulative impacts; industrial mineral activity is unlikely.

Additional Mitigation Measures

Mitigation is not needed. Industrial mineral activity is unlikely.

Unavoidable Adverse Impacts

There are no unavoidable adverse impacts from this activity.

Forest Resources

Timber Resources

The following table summarizes the cumulative impacts of each alternative on the availability of acreage open to commercial harvests, average annual harvests per decade, average harvest volumes per acre, and the annual acreage treated as regeneration, thinning, and partial cut harvests.

Table 14: Timber Resources - Cumulative impacts of each alternative.

	Alternative 1	Alternative 2	Alternative 3	Alternative 4	Alternative 5
Acres available for harvest or restoration activities that are not significantly constrained by management strategies*	11,222	8,016	5,133	3,740	2,044
Percent of 15,657-acre planning area	72	51	33	24	13
Draft average annual harvest per decade (mbf/year)	5,511	2,733	492	428	N/A
Draft average Harvest Volume (mbf/acre)	37	30	9	16	N/A
Draft annual acreage treated as regeneration harvests	89	43	0	0	N/A
Draft average annual acreage treated as thinning harvests	47	35	18	16	N/A
Draft annual average acreage treated as partial cut harvests	11	13	11	9	N/A

Note: These numbers are approximate, resulting from modeling analysis, and used for comparative evaluation for planning purposes only. (Source: Road Summary, Stuart, 2002; Comparison of February 02 Sustainable Harvest Model Run, Brodie, 2002.)

Under this alternative approximately 72 percent of the project area will be available for commercial timber harvest.

Short-term Impacts: Direct and Indirect

Sufficient acreage and volumes would be available to support the immediate harvest operations. Options for access to stands is greatest which also provides for the most opportunity to select a method of logging.

Long-term Impacts: Direct and Indirect

The average rotation age would be 60 years under this alternative. The average site index on operable lands would be highest under this alternative, which would, in turn, support higher yields per acre over the entire planning area. Maintenance of stands dominant with Douglas-fir will continue. The availability of red alder of commercial size will decrease over time. Stands with higher levels of hemlock and cedar will increase.

Cumulative Impacts
Refer to table at beginning of section.

Additional Mitigation Measures
None identified at this time

Unavoidable Adverse Impacts

While the current management policies, the HCP and Forest Practices laws limit access to some of the forest resources on state trust lands in the planning area, these are not considered significant adverse impacts.

Special Forest Products

Short-term Impacts: Direct and Indirect

This alternative provides the most acreage available for the harvesting of special forest products. In addition, vehicular access to sites would be maximized under this alternative.

Long-term Impacts: Direct and Indirect

Those vegetative products needing open conditions and full sunlight will be most abundant under this alternative. Fungal species needing maintenance of deeper, undisturbed layers of organic matter found with longer rotations would not be favored by this alternative.

Possible conflicts with Native American traditional uses of medicinal plants may impact any commercial harvesting.

Cumulative Impacts

Significant adverse cumulative impacts could occur if the intensity and frequency of harvest in specific areas exceeded the potential for regrowth of these products. However, this is unlikely at this time due to the low demand and lack of market for these products.

Additional Mitigation Measures

Mitigation for potential for over-harvesting special forest products and commercial use conflicting with Native American traditional uses could be accomplished by establishing harvest quotas and conditioning permits and/or leases. The information base for setting these quotas would need to be established.

Unavoidable Adverse Impacts
None identified.

Conservation/Preservation (carbon sequestration)

Vegetation and soils are widely recognized as carbon storage sinks. During photosynthesis, plants use sunlight to convert water and carbon dioxide into energy containing organic compounds. Plants consume the energy stored in these compounds and respire carbon dioxide. The balance favors the net accumulation of carbon in trees, shrubs, herbs and roots. About 60 percent of the carbon in forests is stored below ground in organic matter (including roots) and organisms in the soil.

In addition to reducing net carbon emissions, sequestration of carbon in forests offers significant benefits: restored natural environments for plants and wildlife, reduced runoff, improved water quality and quantity, and continued or increased production of forest products.

Methods for monitoring and verifying the amount of carbon stored in ecosystems are slow and imprecise. But in general, young trees store more carbon on an annual basis because they typically grow more rapidly than older trees. The annual uptake of carbon rises during the early growing phase of a forest stand. It then declines as the trees mature and competition for light and nutrients increases. If trees are harvested, there would likely be a negative flux of carbon for several years, before re-growth of the second rotation would begin to take up significant quantities of carbon.

When forests are harvested, the effect on atmospheric carbon dioxide depends on how much carbon was stored in the forest, what happens to the cut wood, and how the lands are managed. Finished wood products store carbon until they decompose. Durable products such as construction lumber retain carbon for

decades or even centuries. If the time scale is long enough, the land is used for a series of harvests, and the harvested wood is converted into durable products or displaces fossil fuels, then forests can be a net sink for carbon.

Alternatives 1, 2, 3 & 4: The level of harvests and length of harvest rotations proposed under each of these alternatives could provide significant opportunities for active net removal of atmospheric carbon and act as long-term carbon sequestration pools.

Harvested trees that are turned into long-lasting products, such as lumber, would continue to sequester carbon. Regenerated harvest areas would provide younger trees that more actively remove and sequester atmospheric carbon.

Built Environment (4.2.2)

ENVIRONMENTAL HEALTH (4.2.2.1)

Release of Toxics/Hazardous Materials

No significant adverse impacts likely.

Risk of Explosion/Fires

There is very limited risk of explosions on DNR-managed lands in the planning area for this and each of the other alternatives because of the absence of factors such as pipelines.

As discussed under "Air," based on zoning laws and past wildfire history (i.e., low number and small size of fires) there is a relatively low risk of fire threatening homes and other structures adjacent to state trust lands under Alternative 1.

Risk of Slides, Floods, Debris Flows

Watershed Analysis prescriptions were developed to minimize disturbance of slopes during road construction and harvest and to prevent slope failures. Additionally, DNR requires assessment of these areas by a slope stability specialist prior to construction. Roads are designed to match slope, soil, rock and drainage characteristics. Potential mitigation measures considered often include use of multiple cut slope angles, structural support or retention of slopes or the road prism, use of bridges or armored fills for stream crossings, to allow passage of debris flows, and paving roads and drainage ditches to reduce erosion.

Short-term Impacts

The potential for short-term impacts to the built environment under this alternative would be minimal. There is some risk in the immediate vicinity of forest road construction projects on unstable and potentially unstable slopes. Removal of support from steep, unstable or potentially unstable slopes while constructing full-bench road segments would likely result in localized debris slides in soil, and debris slides and block glide in rock. Forest road construction on these areas typically would be spatially remote from elements of the non-forest built environment such as public and private roads and structures, public utilities and other facilities.

Impacts could include damage to the new road prism or road closure, blockage of drainage structures, and increased sedimentation into streams. However, there is a low likelihood that these impacts would occur because road construction on unstable and potentially unstable slopes is constrained by Watershed Analysis prescriptions that were developed to minimize disturbance of these slopes and to prevent slope failures. Additionally, DNR requires assessment of these areas by a slope stability specialist prior to construction.

Long-term Impacts

Potential long-term impacts to non-forest elements of the built environment would be damage or destruction by debris flows occurring during periods of intense, prolonged rain-on-snow events. A series of events – local road failure, unusual climatic conditions, initiation of a debris flow, and delivery of the debris flow to elements of the built environment – would have to transpire for damage to occur. If damage occurred, it would likely be in the vicinity of stream channels, at road/stream crossings, and on existing alluvial fans. The potential for these impacts to occur is even less than the short-term impacts discussed above.
Potential impacts to the natural environment are already discussed under "Earth."

Cumulative Impacts

The primary cumulative impact to the transportation infrastructure and other structures would be financial, from recurring reconstruction costs. However, these cannot all be credited to forest management, particularly damage from debris flows to downstream structures on alluvial fans; the natural processes for this area include slides and flooding, which will occur occasionally regardless of the plan alternative.

Potential impacts to fish habitat and water quality are addressed under other sections.

Additional Mitigation Measures

Debris flow impacts could be reduced in some locations by construction of impact structures and catch basins to stop the flow and capture soil and debris. The suitability of this potential mitigation measure is based on site-specific characteristics at the mouth of each channel, coupled with the hydraulic characteristics of flows occurring within the channel.

Unavoidable Adverse Impacts

Significant debris flow events occurred along the incised channels prior to development of the area. Some of the flows were larger than those that have occurred since the initiation of timber harvest. Even in the absence of forest management activities, damaging, destructive debris flows will continue to naturally occur in many of the drainages in the planning area. There will be a continuing threat of property damage and potential loss of life to people occupying the channels and alluvial fans of these drainages.

Spiritual & Emotional Health

No known impacts. See "Affected Environment" discussion.

LAND & SHORELINE USE (4.2.2.2)

Existing Land Use Plans/Growth Estimates

Not applicable. Land use plans and growth estimates are responsibilities of Whatcom County, its jurisdictions and other state agencies. They are not determined by DNR. This alternative should not affect land use plans in areas already zoned commercial forestry. No zoning changes anticipated as a result of this proposal.

Residential and Commercial Development

Not applicable. None of the alternatives will affect residential or commercial development in the planning area.

Aesthetics

All five alternatives include an objective to "reduce the visual impact of forest management activities in high visibility areas as shown on Map S-1" (See Appendix C.) In addition, many citizens raised the question of visual impacts in their scoping comments. This analysis looks primarily at those areas identified as

having "high" and "medium" potential for visual impacts as viewed from six different residential communities.

Riparian, wetland and unstable slopes protection will leave an irregular visual pattern at the larger scale of the landscape. The 100-acre size limit to harvest areas, and the 300-foot buffer between areas that together would exceed 100 acres will also minimize potential visual affects of management activities.

However, more site-specific design features would need to be built into timber sales to soften visual effects in the "high potential" area east of Cain/Reed and in the "high" potential impact area north of Smith Creek. (See Map S-1.)

Short-term Impacts: Direct

Individual timber harvest activities and some road building will have visual impact on residential views. The impacts from harvest activities will be short-term; then the forest will regrow. These site-specific activities are most likely to be visible in the area east of Cain and Reed lakes and north of Smith Creek.

Long-term Impacts: Direct

As one harvest area grows in, another area may be cut so there always will be visual change on the horizon. The long-term forest viewshed should improve over time, however, as the riparian, wetland and unstable slope strategies of the HCP are implemented. New roads, if visible, would create new, long-term visual impacts. With the information currently available, it is difficult to determine how significant this impact would be.

Cumulative Impacts

Due to the dynamic nature of the forest re-growing and the limits on harvest size and buffers between harvest areas, cumulative impacts should be minimal.

Additional Mitigation Measures

A set of sale design strategies could be added to Alternative 1 to soften the visual impacts of harvest areas, particularly in the high visibility areas. This would be especially important in the two areas noted above.

Unavoidable Adverse Impacts

Since aesthetics are subjective, not objective, it is difficult to say that no one will experience what they consider significant impacts. It is the determination here, however, that there will be no significant adverse impacts, particularly if mitigation actions noted above are used

Recreation

All the alternatives are based on an objective to "manage dispersed, low impact recreation.

Access throughout the area by recreational users (horse rider, hiker, mountain biker) will likely remain at current levels due to amount of roads. There will be some temporary localized closures of user built trails (such as the equestrian trails on Stewart Mountain and the Pacific Northwest Trail on Anderson Mountain) during road construction and timber harvest activities.

Due to the expected amount of roads, both active and abandoned, it is expected that recreation use will be dispersed throughout the forest. The level of impact created by recreational users on streams, wetlands and other public resources is not expected to increase.

The amount of enforcement, particularly to discourage off-road vehicle use is not expected to increase since access to major forest road systems are currently blocked by gates in cooperation with other major landowners.

Short- and Long-term Impacts: Direct

On-going forest management activities will continue to affect the user experience in both positive and negative ways depending on the type of user. For instance, the experience of some recreational uses is less affected by the presence of clear cuts, like mountain biking, than others which are more dependent on a less impacted natural setting, like hiking, nature watching and horse back riding. It is difficult to quantify the probable differences. The quality of hunting is expected to remain the same.

Cumulative Impacts
None identified.

Additional Mitigation Measures
None identified as needed.

Unavoidable Adverse Impacts
None identified.

Historic & Cultural Preservation

Alternative 1 is meant to represent current practice, and the policies, laws, and agreements currently in place are identified in the alternatives table in Section 3. DNR has a tribal liaison and a professional archaeologist on staff to help

implement these policies and agreements. Issues and properties are addressed on a case-by-case basis.

There is no dedicated staff in the regions for dealing with cultural resource issues and staff expertise and sensitivity to these issues is varied. Sites can be destroyed or negatively impacted through cumulative actions and a lack of systematic protections. Tribes must continually re-identify sites, and protecting Traditional Cultural Properties is based on the tribe-forester relationship. There is no mechanism for dealing with Traditional Cultural Properties. An individual forester may bound a sensitive cultural site out of a timber sale based on his personal knowledge of that site, but there is no process for long-term protection of such a site.

The risk to sites is ameliorated by the fact that many sites are partially or completely protected by other mechanisms such as riparian management buffers, wetland buffers, wind buffers etc. The table below is an estimate of the additional acreage necessary to protect cultural resource sites in the Lake Whatcom watershed.

Table 15: Estimated Additional Acres Necessary to Protect Cultural Resource Values to Proposed Standards in Lake Whatcom Watershed Cultural Resource Assessment Matrix under Alternatives 1, 2, 3. 4 and 5.

Type of Use	Alt 1	Alt 2	Alt 3-5	Comments & Assumptions
Ritual Bathing	72	1.5	0	100-foot additional buffer ¼ mile upstream and ¼ mile downstream. Acreage given is absolute minimum. Other bathing areas are certainly present—*10 Sites Assumed*
Spirit Quest / Traditional Song Places Sections:				
12	128	32	16	Roads remove 50% of suitable area, Alternative 2- 50%, Alternative 3-80, Alternative 4-90 % Off Base
17	0	0	0	100 % Protected Under all Alternatives
18 & 19	140	84	28	Road removes 40 acres of suitable area, Alt. 2- 50%, Alt. 3-70%, Alt. 4- 90% Off Base
20	128	96	80	Alt. 2-20%, Alt. 3-40 %, Alt. 4- 50% Off Base
Subtotal	396	207	124	
Ceremonial Flora/Medicine Sites	12.5	0	0	This assumes 50 sites in wetlands less than ¼ acre.
Gear Storage Sites	500	150	75	This assumes 100 unknown gear storage sites throughout watershed and that 50% are covered under other buffers under

CMTs				Alternative 2, 70% under Alternative 3, and 85% under Alternative 4—*100 CMT Sites*
Old Growth	0	0	0	Region has stated that there will be no harvest of old growth, therefore no additional acreage is needed to protect cultural resource aspects of old growth.
Totals	980.5	358.5	199	

Note: Acreage amounts given are estimates only and represent only known resources except for gear storage sites and ceremonial flora/medicine sites where numbers are projected. Only resources from the Lummi Nation and the Office of Archeology and Historic Preservation are included. Information from the Nooksack Tribe was not available when this table was compiled. Other cultural resources may exist

It should also be noted that some elements of the Forest Resource Plan and Habitat Conservation Plan are still being implemented, due to prioritized budget constraints. Alternative 1 includes establishing a cultural resource program that, at minimum, meets regulatory standards (DNR policy PO06 - 001 Historical, Cultural and Archeological Sites). While initial steps have been taken, DNR is still in the process of fully establishing this program. In addition to meeting state law, the program will need to satisfy federal regulatory standards in order to meet HCP commitments. Federal regulatory standards for cultural resources are generally considered to be the regulations and guidelines associated with Section 106 of the National Historic Preservation Act. (For a synopsis of the Section 106 process see Appendix D, Cultural Resources Assessment.). :

Short- and Long-term Impacts: Direct and Indirect

At present, known sites that are recorded with OHAP receive the best protection under Alternative 1. All other sites are at some risk of damage. Non-recorded archaeological sites potentially impacted include battlefield sites, petroglyphs, trails, up to fifty culturally modified tree sites over 500 acres, fishing sites and burial sites. Traditional Cultural Properties potentially impacted include ten plus ritual bathing sites, 396 acres of spirit quest/traditional song places, up to fifty ceremonial flora/medicine sites, and up to fifty gear storage sites.

It is difficult to determine how probable or significant the adverse impacts would be for all sites, particularly since the cultural resources program is still developing. However, the qualities needed for bathing sites and spiritual sites do require a degree of purity, privacy and isolation that would be impacted by most management activities, and their spiritual dimensions are usually not transferable to another site (see Cultural Resources Assessment, Appendix D). In addition, some management activities may result in short-term impacts (e.g., harvest exposing a site that brush grown soon obscures) and others long-term (e.g., road construction and subsequent traffic destroying the privacy of a bathing site.)

Cumulative Effects

Some activities that will not have adverse impacts if they occur only once can become damaging if they occur repeatedly. For example, a single harvest may have only minor impacts on the purity of a water body. However, multiple harvests may spiritually contaminate a bathing area. In addition, a combination of different activities can have a cumulative effect on a site. For example, roads into an area may not themselves be a problem, but when the roads bring harvest activities or even recreationists into a ritual bathing area the combination negatively impacts the ritual experience due to the lack of isolation and privacy.

Additional Mitigation Measures

A more systematic approach to cultural resources protection would help mitigate potential damage to these resources. This situation will improve as the department's cultural resource program is more fully established and matures. Until that occurs, the best mitigation would be to avoid management activities in locations most likely to contain cultural resources.

Unavoidable Adverse Impacts

It is likely there will always be some sites not identified regardless of the procedures put in place, since some are unknown and the level of survey needed to find every site is not feasible.

Agriculture

Not Applicable: DNR holdings in the planning area typically are zoned for commercial forestry. The planning area contains no lands specifically designated as agricultural lands under the Whatcom County Comprehensive Plan.

Silviculture

This alternative supports all silvicultural activities as allowed by federal and state laws, Forest Resource Plan policies, the Habitat Conservation Plan, and other Board of Natural Resources approved policies and management guidelines. All types of silvicultural systems suitable to management of Westside forests are also supported. Under this alternative, 72 percent of the project area will be available for commercial timber harvest.

Regeneration of stands will continue to emphasize current practices of artificial regeneration of Douglas-fir and western red cedar. Natural seeding will be utilized at higher elevations. Aggressive site preparation and competing vegetation control will occur during the first ten years including use of herbicides. Current polices concerning snag and green tree can reduce the ability to conduct

safe aerial operations particularly if trees are scattered, rather than clumped, across a unit.

Precommercial thinning will probably be employed on all stands. The access, and selection of logging methods allowable under this option, will improve the probability of commercial thinning will produce acceptable rates of return.

Short- and Long-term Impacts: Direct and Indirect

There are no significant adverse impacts on the department's ability to use effective silvicultural techniques to achieve the landscape objectives

Cumulative Impacts

The ability to control stand structure, stand composition and density, control rotation length, facilitate harvesting, and maximize timber yields are optimized under this alternative.

Additional Mitigation Measures

After a review of each site, the department selects from the following methods for controlling vegetation: no treatment, non-herbicide, ground-applied herbicide, and aerial applied herbicide. A method lower on the list may be used only if it substantially outperforms other methods (Forest Resource Plan Policy # 33).

Unavoidable Adverse Impacts

The potential environmental impacts of various silvicultural approaches are covered under the "Natural Environment" topics. Since these alternatives are policy issues, none of the limitations on silvicultural tools are unavoidable.

TRANSPORTATION (4.2.2.3)

Transportation Systems

The amount of road construction in each decade, under Alternative 1, would depend on the length of time planned for all timber harvest to occur. Assuming it takes 60 years for all stands to be harvested under this alternative, this would result in roughly 10 miles of new roads being built in the first decade. Approximately 61 miles of new road would be constructed before the full transportation system is in place.

The combination of log and rock haul likely under Alternative 1 would result in an average of 15 truck trips per day generated by forest management activities on

DNR forests in the watershed. This number reflects two passes for each truck on a round trip and assumes that work occurs every Monday through Friday.

Constructed roads would require rock to be consumed from local surface mines. Truck traffic would cause wear on road surfaces, requiring maintenance work. This hauling will contribute to the traffic and maintenance needs on public roads and some private forest roads, as well as state trust lands.

Short- and Long-term Impacts: Direct and Indirect

Other sections discuss the potential impacts of roads on mass-wasting, sediment delivery, fish habitat, wildlife habitat, etc. However, DNR's HCP and forest practices rules include extensive requirements related to road construction and maintenance in order to mitigate potential impacts; many of the environmental benefits of these new requirements have not had time to play out on the landscape.

DNR's Habitat Conservation Plan (page IV.62) outlines possible mitigation measures for roads built on unstable slopes, "Roads will be allowed to pass through such areas, but they must be engineered to minimize, to the fullest extent feasible, the risk of mass wasting and be routed through the use of a comprehensive landscape-based road network management process." These measures involve steps in the planning, design, construction, road use, maintenance, and abandonment of roads on unstable slopes.

Maintenance work that is done under the Road Maintenance and Abandonment Plan would improve the condition of existing roads.

Abandonment of roads that are not needed for current management activities would limit the overall length of the active road network.

Cumulative Impacts

The traffic from DNR activities contributes to the maintenance needs on public streets, but not at significant levels.

Cumulative impacts on the environment are addressed under "Natural Environment" topics earlier in this section.

Additional Mitigation Measures

None identified.

Unavoidable Adverse Impacts

Alternative 1 would require roads to be constructed. The time period in which they are used would range from one season to the full span of DNR management of the land. Although some roads would be abandoned, the total length of active roads in the planning area would increase. Ongoing maintenance will be required.

The use of rock is necessary for building durable roads and reducing surface erosion.

Forest Road Maintenance and Abandonment Plans

The Road Maintenance and Abandonment Plan (RMAP) for all active and orphaned roads must be completed by 2005, the legal deadline that applies to all forest landowners. DNR plans to complete the RMAP assessment phase within one year of completion of the landscape plan. Orphaned roads must be treated where a clear risk to public safety or potential for resource damage exists and accessing the site will not cause greater resource damage or public risk. All maintenance and abandonment work planned under the RMAP must be completed by 2015. Weather events that occur prior to 2015 could potentially cause damage or failure of existing roads. Potential environmental impacts from roads are covered under "Natural Environment".

Short- and Long-term Impacts: Direct and Indirect

Road maintenance and abandonment work will reduce the risk of environmental damage. This work will cost significant amounts from management funds, but the long-term result may be a more efficient road system and lower maintenance costs.

Cumulative Impacts
None identified.

Additional Mitigation Measures

Maintenance or abandonment work identified by the RMAP could be completed sooner than 2015 to reduce the potential for damage or failure due to problems found in the assessment stage.

Unavoidable Adverse Impacts
None identified.

Traffic Hazards/Safety

Any traffic, including that generated by activities on DNR managed lands, carries with it a potential for safety problems.

Risks exist for recreational use of forest roads. However, forest roads in the watershed are closed to unauthorized vehicle traffic. When recreational vehicle use is allowed, DNR tries to provide information and cautions about forest road use.

Haul trucks sharing public streets could pose hazards to other vehicles and pedestrians, but no differently than other large trucks. Vehicles entering public roads from the forest road networks are subject to standard traffic laws.

Short- and Long-term Impacts: Direct and Indirect

Haul traffic is not expected to have significant adverse impacts on traffic or safety. Some localized safety situations could arise, however.

Cumulative Impacts
None identified.

Additional Mitigation Measures

Specific safety plans could be required of contractors when haul routes include public streets, such as time of day of hauling and/or number of loads.

Unavoidable Adverse Impacts

Activities on DNR managed lands would increase the traffic levels on forest roads and public streets. The distribution of this increase would vary over time.

Water, Rail and Air Traffic

Not Applicable: No rail lines pass through the planning area. Impacts on air traffic would be limited to the use of helicopter logging of DNR-managed lands within the watershed where appropriate.

PUBLIC SERVICES & UTILITIES (4.2.2.4)

Relation to Trust Income

The relationship of trust land ownership to overall ownership within the landscape can be found in Section 2.5. As explained in Section 2.6, state trust lands in the Lake Whatcom Landscape generate revenue for seven different trusts. The amount of land in each trust is shown in that section.

Alternative 1 dedicates over 50 percent of the trust lands' productive capacity for ecological and social benefits (Hulsey, 2002; see Appendix D). The percentage of

land each trust contributes to what is constrained relative to timber harvest under each alternative is shown in the graph below. This percentage provides a general indicator of the potential revenue impacts to that trust.

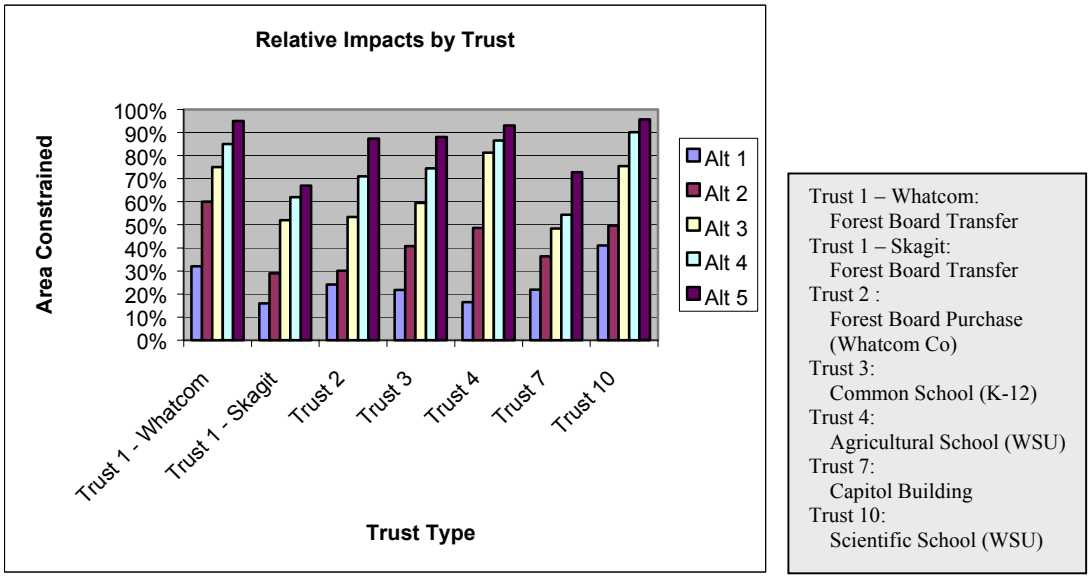

Figure 3: Relative Impacts of Each Alternative (area constrained) by Trust.

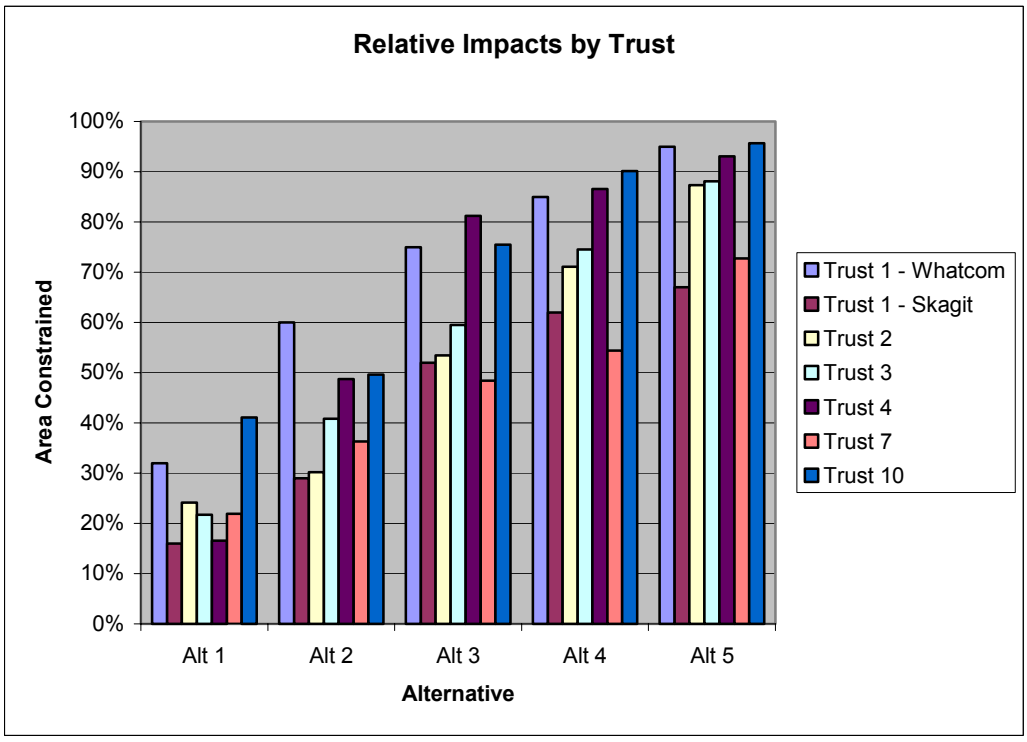

Figure 4: Relative Impacts (area constrained) Among Trusts under each Alternative.

There are several potential revenue sources for the Lake Whatcom landscape, in addition to timber and other traditional revenue sources. Several of these options are included in Alternative 1: (1) green certification; (2) carbon sequestration; (3) land leases; (4) conservation easements; (5) recreation leasing; and (6) exchanging or selling lands. Unfortunately, none of these revenue options can be immediately implemented with confidence that anticipated income will be realized under Alternative 1 - or Alternatives 2, 3, 4, or 5. Therefore, a comparative financial analysis was completed for carbon sequestration, green certification, and recreation leasing using Alternative 1 (and associated revenue assumptions) as a "zero" baseline against which to compare Alternatives 2, 3, 4 and 5. The analysis thus estimates what revenues would need to be earned in order to offset reductions in timber harvest revenues (Glass, 2002; see Appendix D), as a basis for then assessing the likelihood of revenues from these sources offsetting reduced timber revenues.

Fire

Short-term Impacts: Direct and Indirect

Short-term direct impacts of fire on DNR-managed lands include damage to the forest itself, risk of damage to neighboring properties, loss of habitat and potentially increased risks to water quality. In both the short and long term fires pose potential loss of trust assets in the form of timber and other forest products, and the associated reduction in income potential for the federally granted trusts and counties, should Forest Board lands be damaged by fire. Fire damage also could negatively affect aesthetics, both from the standpoint of views and through diminished desirability of the Lake Whatcom area for recreational use. Reduced income as a result of fires could affect the amount distributed to local fire districts from harvests on Forest Board lands.

Police

No impact on police infrastructure, since state trust lands do not generate revenues for local police.

Schools

Timber harvests from Common School trust lands contribute funding for K-12 school construction. Forest Board contributions to the state general fund also may provide support for educational needs. Alternative 1 provides the greatest opportunity for timber management of the five alternatives.

Parks & Recreation facilities

There are no parks or developed recreation facilities located on DNR trust lands. No direct impacts to facilities located on adjacent public or private lands are expected.

Management of DNR trust lands is not expected to have any significant long term or indirect impacts to adjacent parks or recreation facilities.

Communications

No impact to communication sites leases, nor limiting of new site opportunities, since DNR will continue to lease communication tower and building space to interested parties, will increase rental rates when market conditions allow and will seek new customers..

Water/storm water management

Not Applicable

Sewer/solid waste management

Sewer and solid-waste management primarily affects residential and commercial areas. State trust lands in the Lake Whatcom planning area are generally slated for long-term resource use. Most of the DNR-managed property within the planning area has been designated in the county comprehensive plan as commercial forestland of long-term significance. Consequently, there is no significant need for or impacts to sewer infrastructure on DNR-managed lands under any of the alternatives. Solid waste management on DNR-managed lands is limited to cleanup of illegal dumping.

Other government services or utilities

Not applicable.